SIMULATION OF COLD HEADING PROCESS IN AFDEX AND ITS APPLICATION TO PROCESS DESIGN OF CONNECTING SLEEVE, ADMISSION VALVE, STEEL ROLLER AND HUB

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Abstract

Metal forming is a process of metal that is plastically deformed to shape into desired geometry. It can be classified into 2 major groups which is Bulk deformation and Sheet metal working process. Bulk deformation is a process when work formed has low surface area to volume ratio. While sheet metal working is metal being processed has high surface area to volume ratio. In this research, we are focusing in one of bulk deformation process which is called cold heading. Head ing is a metalworking process which incorporates the forging, extruding and upsetting process. However, the manufactu ring process today takes a long time to obtain the suitable dies and parameters for producing a good product. New techn ologies such as AFDEX can be a better alternative way to improve production methods. AFDEX works as simulator for metal forming process. Thus, the objective of this research is to analyse simulation of cold heading process and its appli cation to design process for product. We had designed dies for product using AutoCAD and obtained the important par ameters from the AFDEX software. In conclusion, this study would give significance of cold forging process by using AFDEX software.

Introduction

What is cold heading?

A process that increase the cross-sectional area of a blank a t room temperature. It consists of three process which is forg ing, extrusion and upsetting.

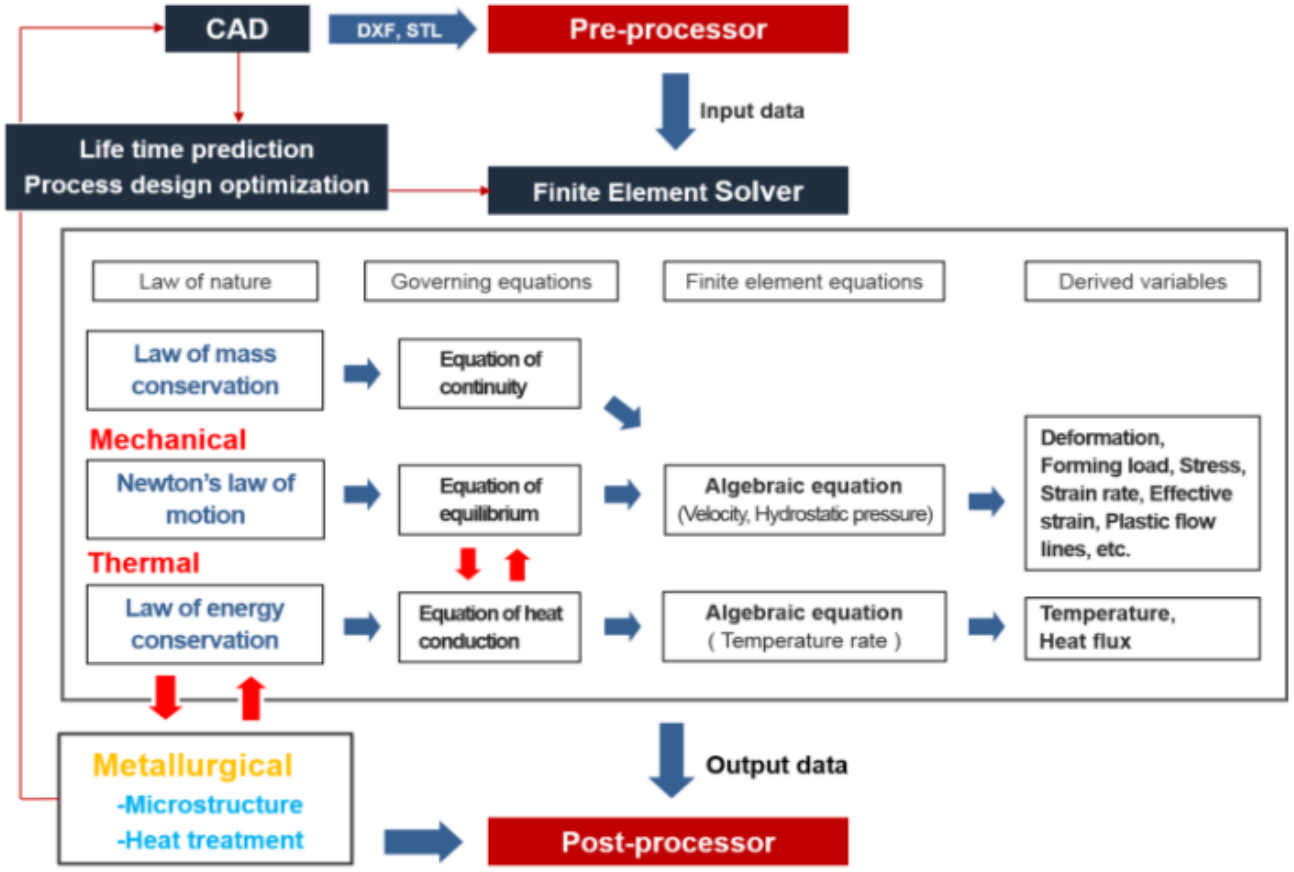
How it process ?

Blank will have many stages and move through multi-sectio n of machine with higher speed

What is the advantage of cold heading compare to mac hining?

- Will increase strength of the material due to cold working process
- Grain flow can be controlled
- Use all the material (almost no material)
- Higher production rate

What is AFDEX software?



Objectives

1. To design the dies for products using Auto Cad
2. To analyse simulation of products in cold forging process by using AFDEX software.
3. To apply AFDEX as an alternative software to reduce product’s lifecycle from procurement to lead time and rework.

Methodology

1. Product Selection and materials properties research

2.Process Design

Draw product process design for each stage using autocad.

3.Dies design

Design upper and lower dies in AutoCad for each stages.

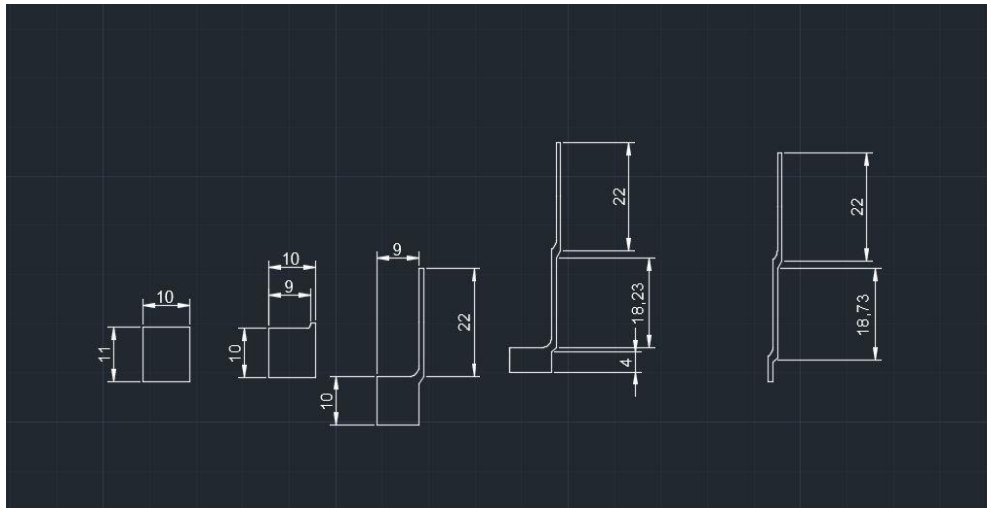
4. Import to Afdex

Import dxf file to Afdex and run simulation to obtain the all the value.

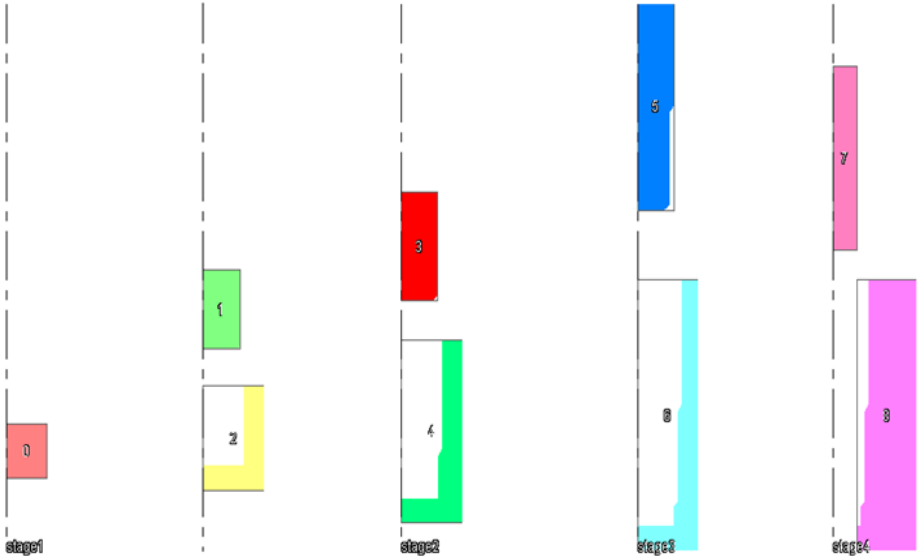
5.Result and Discussion

Connecting sleeve

Process design



Die design

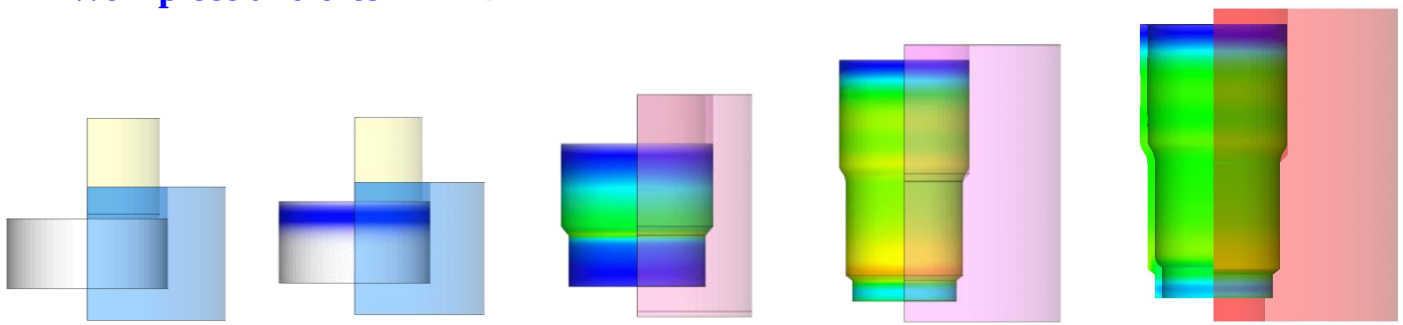


Process description

⊙ Process type: Isothermal analysis, cold-forging, four-stages

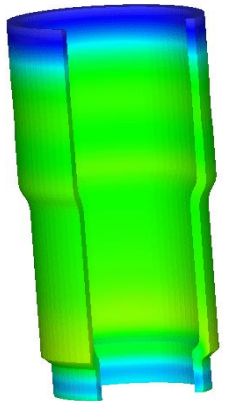
MATERIAL INFORMATION	DIES INFORMATION	STROKE
➢ AISI 1015 (T=20°C) ➢ A SOLID CYLINDRICAL SLICE OF ROD ➢ DIMENSION 10 X 11 mm ➢ INITIAL TEMPERATURE : ROOM TEMPERATURE	➢ FRICTION : SOAP COLD STEEL HYBRID ➢ DIE VELOCITY : CONSTANT (UPPER DIE :-1 mm/s, LOWER DIE:0.00 mm/s)	➢1S - Y VELOCITY : 10.85 mm ➢2S - Y VELOCITY : 10 mm ➢3S - Y VELOCITY : 5 mm ➢4S – PIERCING RATIO: 0.1 mm

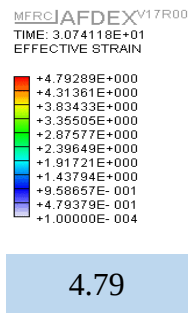
Workpiece and dies in AFDEX



Initial | Stage 1 | Stage 2 | Stage 3 | (Piercing)

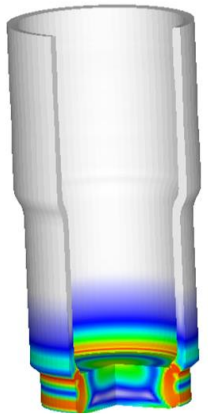
Connecting sleeve

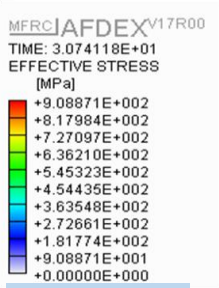




4.79

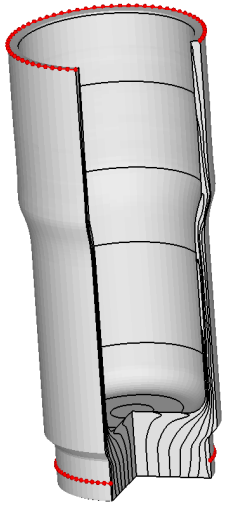
EFFECTIVE STRAIN



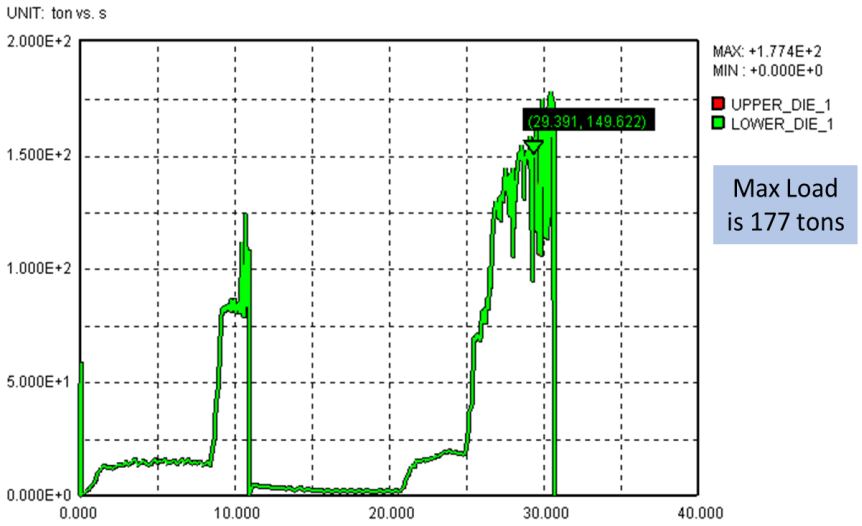


909 Mpa

EFFECTIVE STRESS

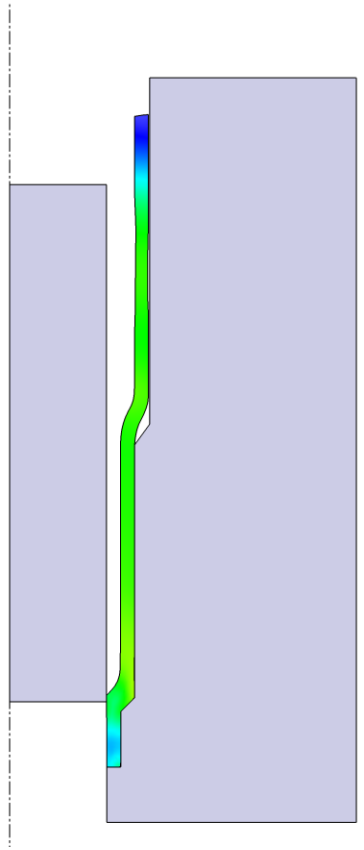


FLOWLINE



Max Load is 177 tons

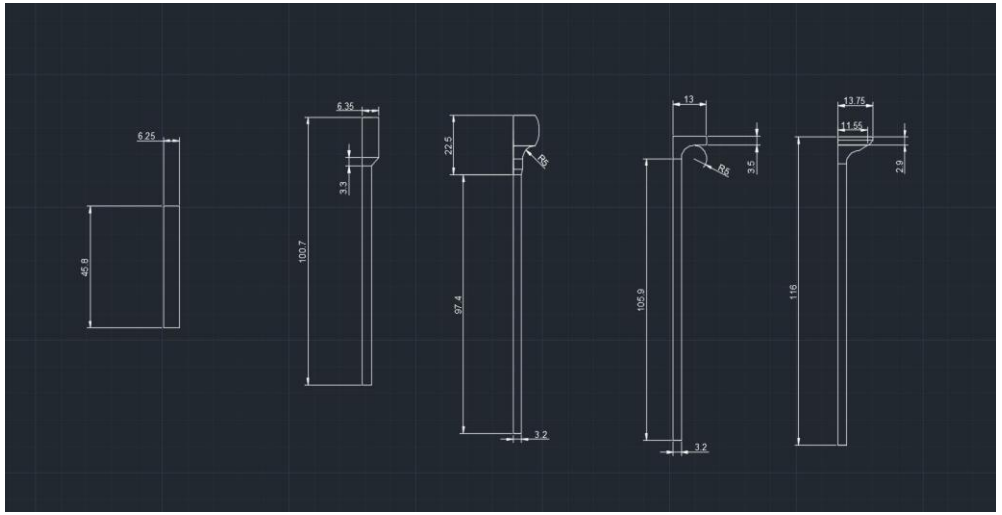
LOAD VS YY GRAPH



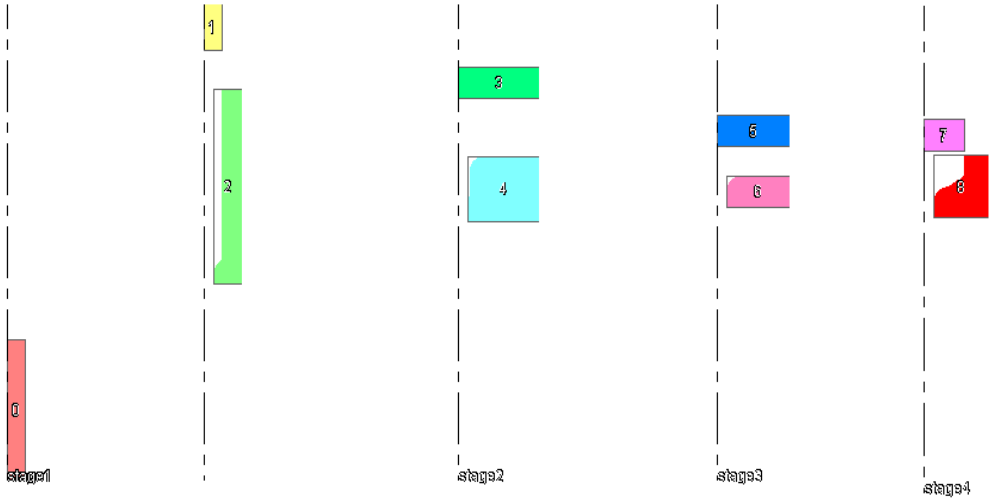
SIMULATION

Admission Valve

Process design



Die design

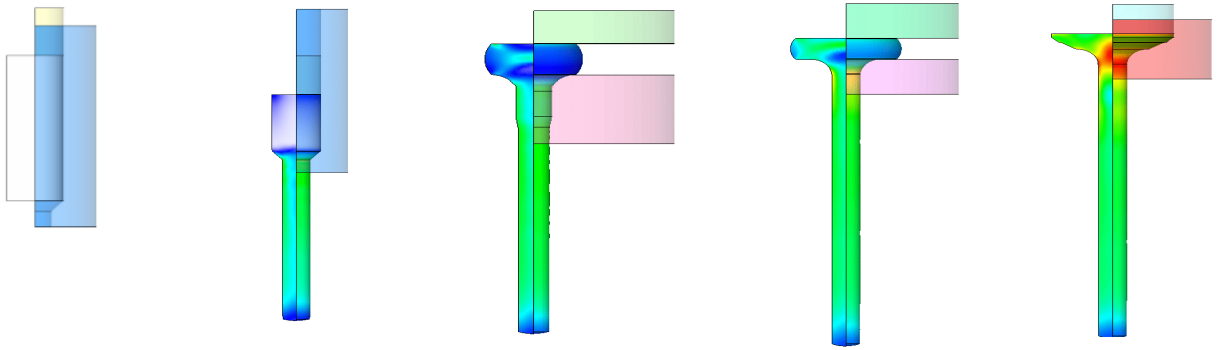


Process description

⊙ Process type: Isothermal analysis, cold-forging, four stages

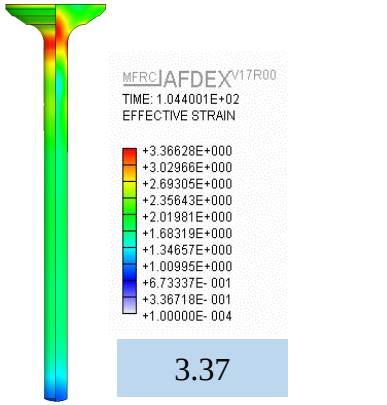
MATERIAL INFORMATION	DIES INFORMATION	STROKE
➢ AISI 1020 (T=20°C) ➢ A SOLID CYLINDRICAL SLICE OF ROD ➢ DIMENSION 6.25 X 45.8 mm ➢ INITIAL TEMPERATURE : ROOM TEMPERATURE	➢ FRICTION : SOAP COLD STEEL ➢ DIE VELOCITY : CONSTANT (UPPER DIE :-1 mm/s, LOWER DIE:0.00 mm/s)	➢1S - Y VELOCITY : 22 m m ➢2S - Y VELOCITY : 9.5 mm ➢3S - Y VELOCITY : 6 m m ➢4S - Y VELOCITY :1.15 mm

Workpiece and dies in AFDEX



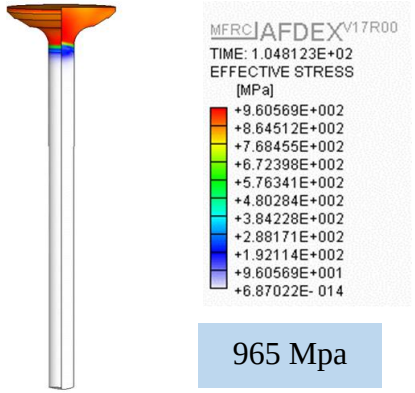
Initial | Stage 1 (Extrusion) | Stage 2 (Upsetting) | Stage 3 | Stage 4

Admission Valve



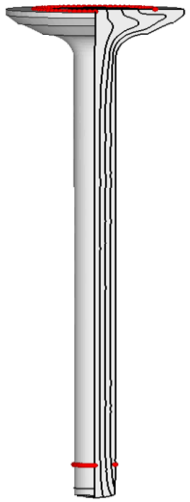
3.37

EFFECTIVE STRAIN

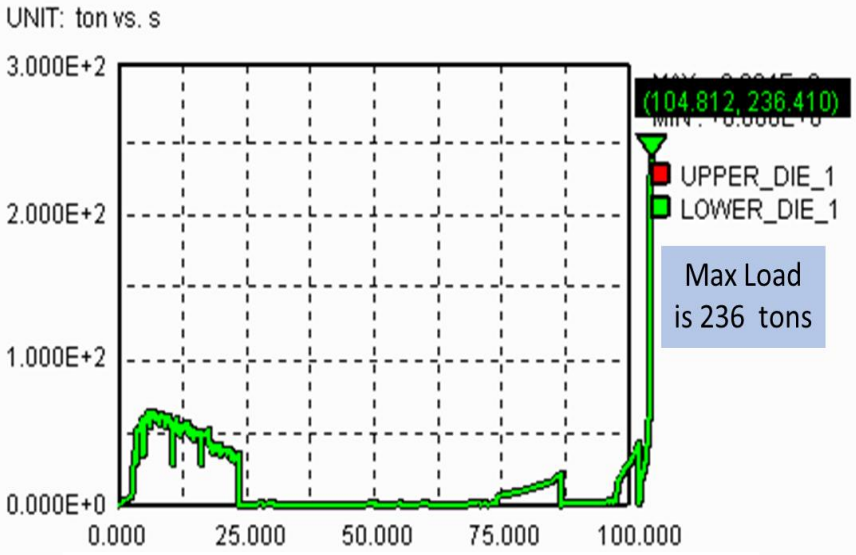


965 Mpa

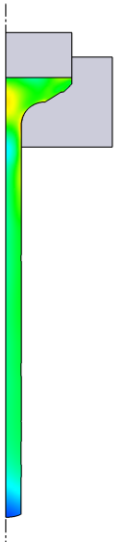
EFFECTIVE STRESS



FLOWLINE



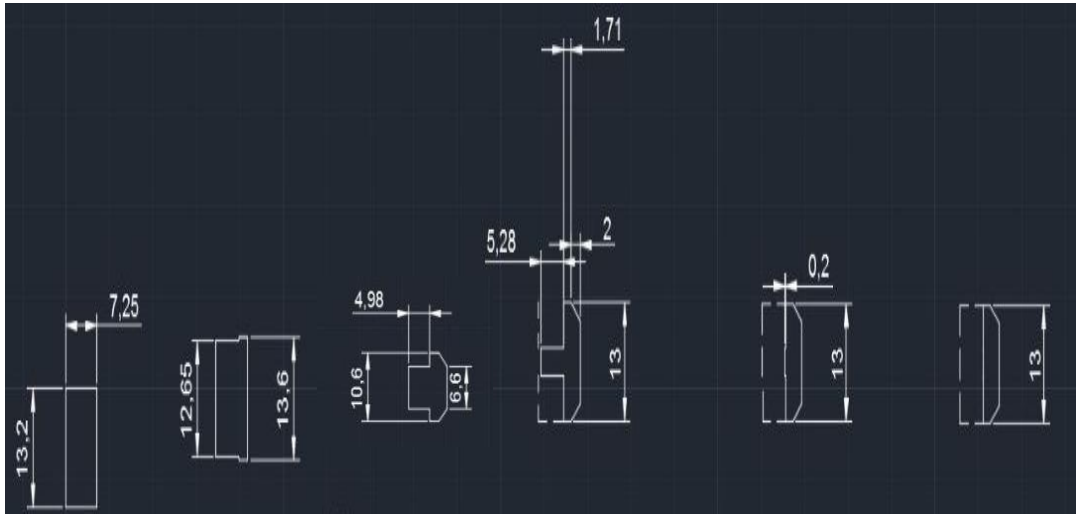
LOAD VS YY GRAPH



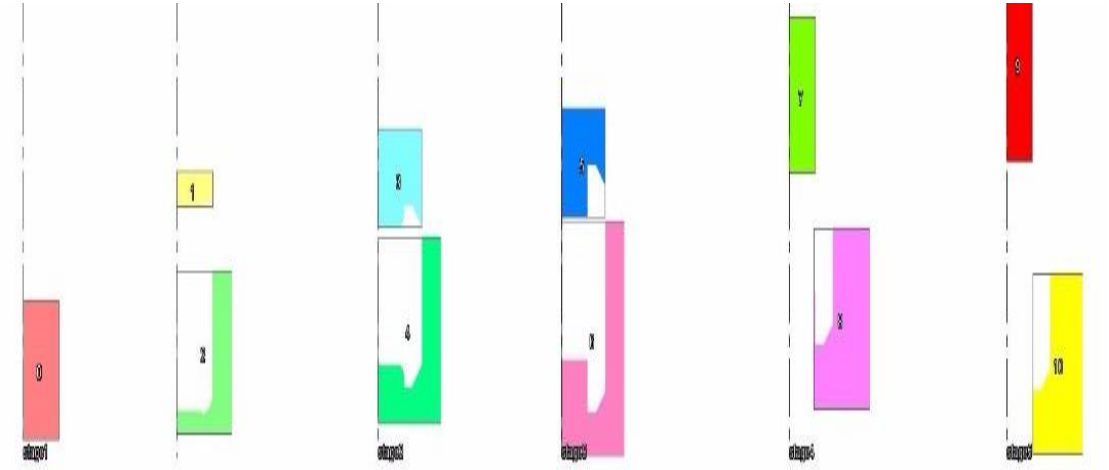
SIMULATION

Steel Roller

Process design



Die design

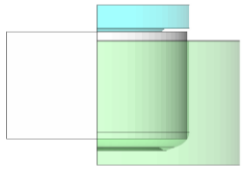


Process description

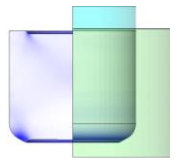
⊙ Process type: Isothermal analysis, cold-forging, five-stages

MATERIAL INFORMATION	DIES INFORMATION	STROKE
➢ AISI 1015 (T=20°C) ➢ A SOLID CYLINDRICAL SLICE OF ROD ➢ DIMENSION 20 X 20 mm ➢ INITIAL TEMPERATURE : ROOM TEMPERATURE	➢ FRICTION : OIL COLD STEEL HYBRID ➢ DIE VELOCITY : CONSTANT (UPPER DIE :-1 mm/s, LOWER DIE:0.00 mm/s)	➢1S - Y VELOCITY : 12.5 mm ➢2S - Y VELOCITY : 6.4 m m ➢3S - Y VELOCITY : 2.28 mm ➢4S – PIERCING RATIO : 30 mm ➢5S – PIERCING RATIO : 30mm

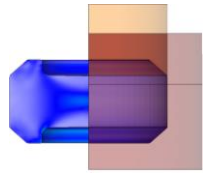
Workpiece and dies in AFDEX



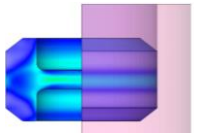
Initial



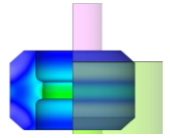
Stage 1



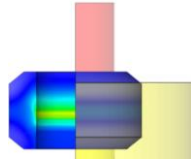
Stage 2



Stage 3

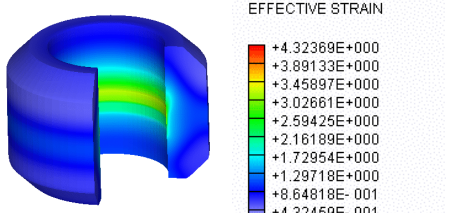


Stage 4 (Piercing)



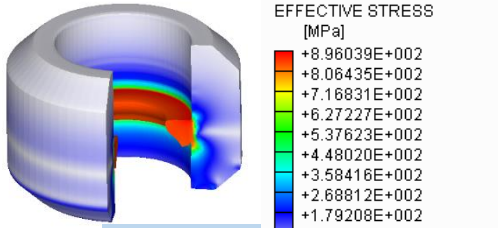
Stage 5 (Piercing)

Steel Roller



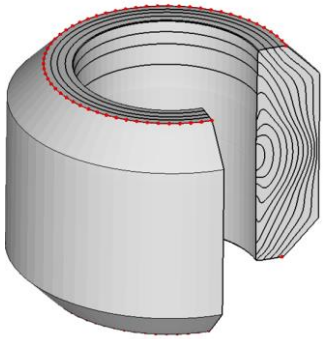
4.32 Mpa

EFFECTIVE STRAIN

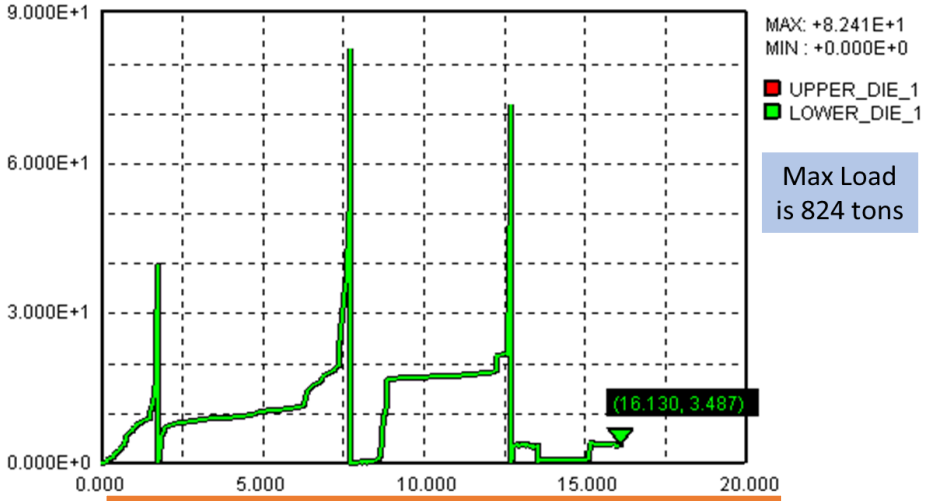


896 Mpa

EFFECTIVE STRESS

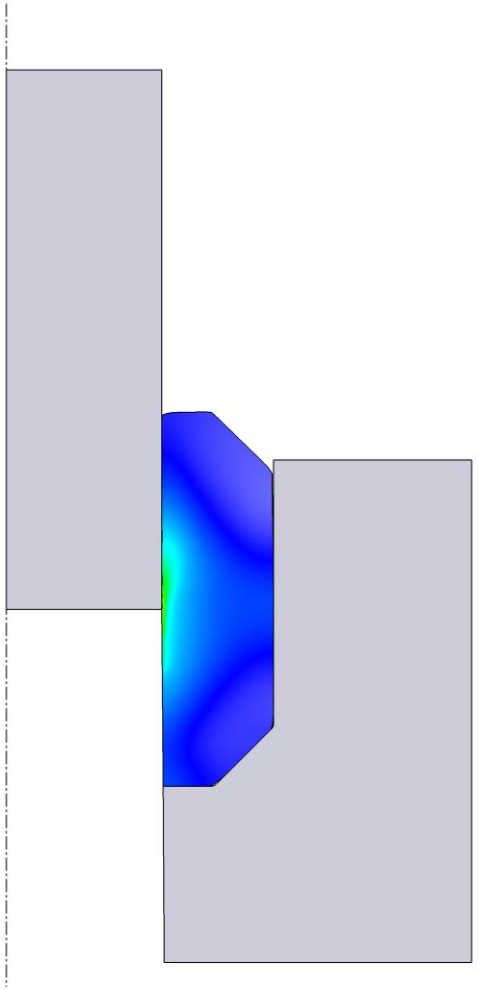


FLOWLINE



Max Load is 824 tons

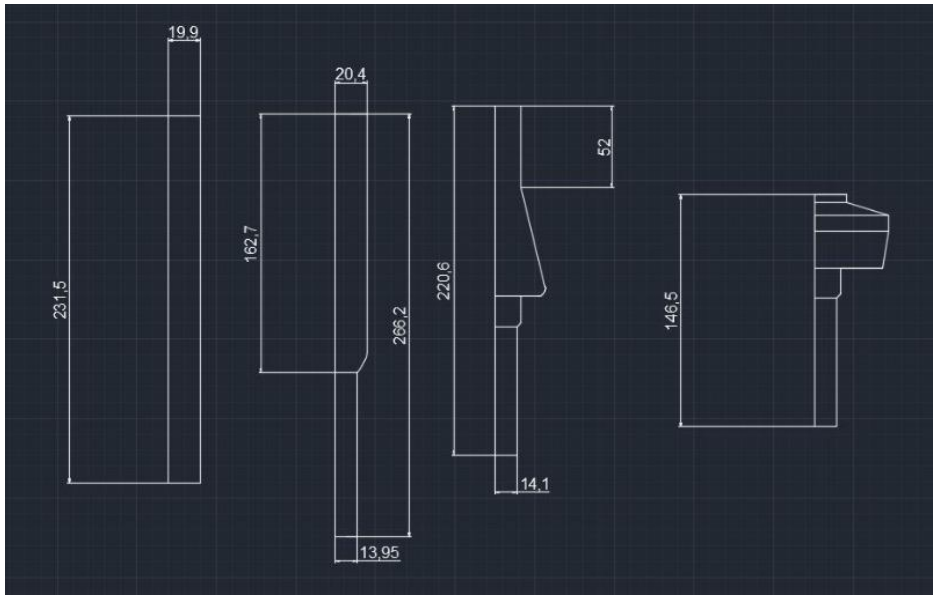
LOAD VS YY GRAPH



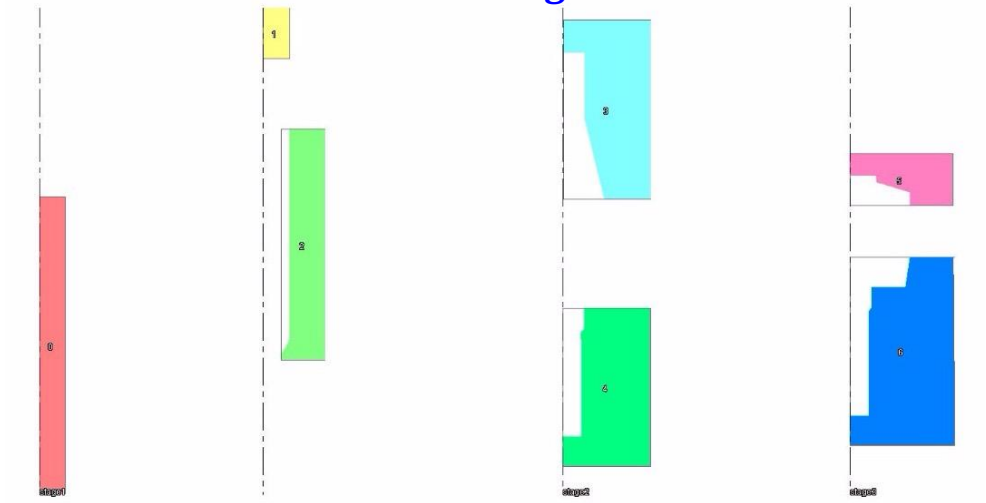
SIMULATION

Hub

Process design



Die design

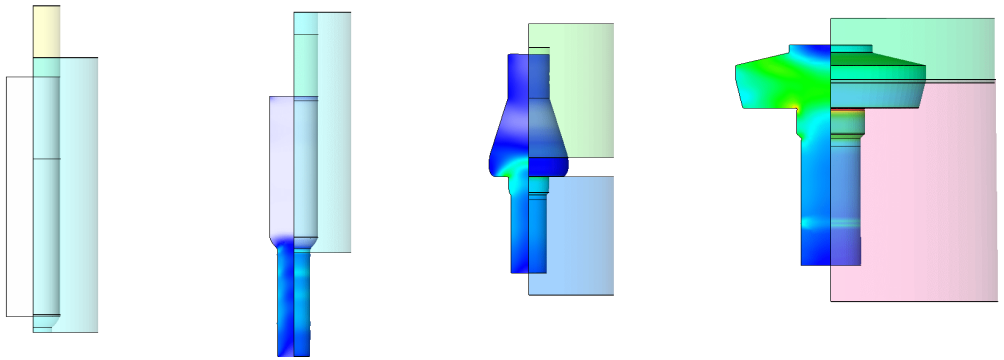


Process description

⊙ Process type: Isothermal analysis, cold-forging, three-stages

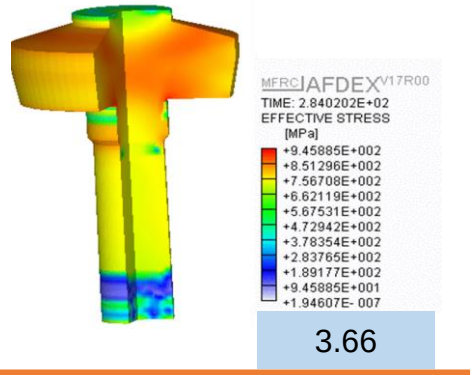
MATERIAL INFORMATION	DIES INFORMATION	STROKE
➢ AISI 1010 (T=20°C) ➢ A SOLID CYLINDRICAL SLICE OF ROD ➢ DIMENSION 20 X 20 mm ➢ INITIAL TEMPERATURE : ROOM TEMPERATURE	➢ FRICTION : SOAP COLD STEEL ➢ DIE VELOCITY : CONSTANT (UPPER DIE :-1 mm/s, LOWER DIE:0.00 mm/s)	➢1S - Y VELOCITY : 167.7 mm ➢2S - Y VELOCITY : 20 mm ➢3S - Y VELOCITY : 40 mm

Workpiece and dies in AFDEX



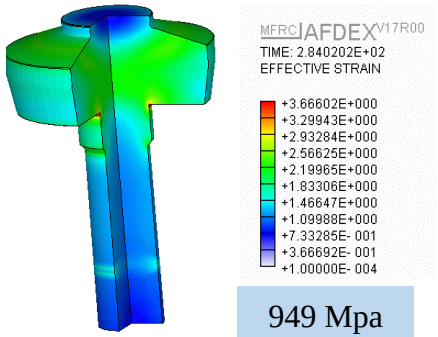
Initial | Stage 1 (Extrusion) | Stage 2 | Stage 3

Hub



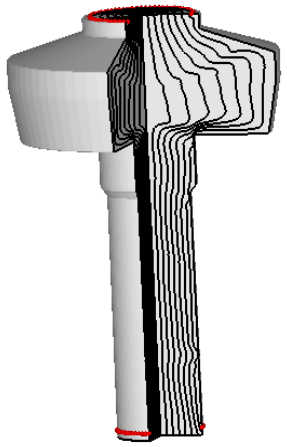
3.66

EFFECTIVE STRAIN

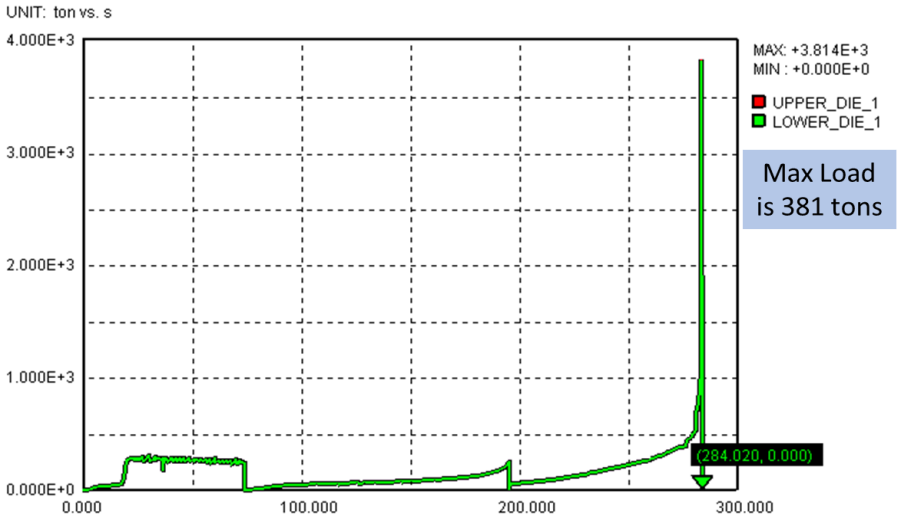


949 Mpa

EFFECTIVE STRESS

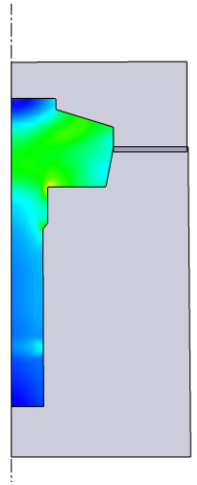


FLOWLINE



Max Load is 381 tons

LOAD VS YY GRAPH



SIMULATION

Conclusion

- UPPER DIE AND LOWER DIE FOR EACH PRODUCT HAD BEEN DESIGNED PROPERLY.
- ALL THE IMPORTANT PARAMETERS SUCH AS EFFECTIVE STRESS, EFFECTIVE STRAIN AN D LOAD VS TIME GRAPH HAD BEEN OBTAINED AFTER THE SIMULATION HAD COMPLETED.
- AFDEX SOFTWARE CAN BE USE FOR SIMULATING COLD HEADING FORGING PROCESS A S A NEW ALTERNATIVE WAY FOR FORGING INDUSTRY.